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ABSTRACT

Piaget's conservation experiments have been criticized and reinterpreted in the light of various theoretical orientations. Some research studies suggest social as well as cognitive factors to explain children's answers. Other research indicates the importance of interaction variables in the conservation task. Actually, interaction in the conservation experiment is an alienated relationship. The use of clinical interviews to study conservation is counter-indicated, for ignorance of the rules of interaction particular to examination may contribute to young children's failure in such tasks. Some critics of Piaget appear to think that children master the conservation problem at a much earlier age than Piaget contended. The age question, however, is a mistaken question that is unlikely to be answered. The availability of a cognitive ability is not a matter of possessing or not possessing. Cognitive development does not lead spontaneously to general and generalizable concepts, but should be thought of as the development of specific cognitive abilities, which are more or less tied to particular contexts. In keeping with this point of view, an experimental task should not be considered as a means to reveal the competence the child possesses. The experiment should be thought of as a novel situation to which the child must adapt and transmit existing knowledge by active construction. (Included in the discussion are examples of children's confrontations with conservation problems in the context of everyday life.) (RH)

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The Social Psychology of the Conservation Task

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Piaget's conservation experiments have been criticised and re-interpreted in the light of various theoretical orientations. According to some investigators, the child's failure in the conservation task is not due to a lack of operational ability, but to unfamiliarity with the terminology used, or to immaturity of the perceptual and attentional functions (Siegel & Hodkin, 1982). Others explain the results of the conservation experiments by appealing to other developmental processes, such as the transition from iconic to symbolic representation (Bruner, 1973), or growing understanding of the possibility to use a measure in comparing two stimuli (Bower, 1979). Still others maintain that the reasoning abilities which are necessary to solve the conservation problem are not the consequence of a new stage in cognitive development, but can be taught by training procedures (Galperin, 1957; Engelmann, 1971).

The interpretation of Donaldson (1978, 1982, McGarrigle & Donaldson, 1974) differs from these points of view in that she advances not only cognitive, but also social factors to explain the answers of the children. According to her account, young children, in contrast to older children and adults, are not yet able to understand verbal utterances cut loose from a context of action: "it now looks as though he (= the child) first makes sense of situations (...) and then uses this kind of understanding to help him to make sense of what is said to him." (1978, p. 59). In the conservation experiment misunderstandings arise, because the child witnesses an action performed by the experimenter (the undoing of the perceptual similarity of two stimuli), which is completely irrelevant to the question put forward thereafter. To answer the question correctly, the child must understand it independently of what the experimenter does. But because their attention is directed to the transformation, some children interpret the experimenter's question wrongly. For instance, in a conservation of number task, the question about the number of counters in the two rows is understood as a question as to which row is the longer one.

To test this theory, McGarrigle & Donaldson designed an experiment in which the transformation appears to be performed accidentally and against the experimenter's will. If the transformation is not executed

by the experimenter, they argued, a conflict between the actions of the experimenter and the conservation question is avoided. Therefore the child, in listening to the experimenter's words, will not attach much importance to the changed perceptual configuration. Their 80 subjects (4;2 to 6;3 years old, mean age: 5;4) had to solve a number of conservation problems (conservation of number and length). In half of the tasks the classical procedure of Piaget was given, in the other half the transformation was carried out by a teddy-bear escaping suddenly from a box and changing one of the stimuli. Using a strict criterion, the investigators found that only 13 of the 80 children were succesful in the classical procedure, whereas 50 of the same children were diagnosed conservers in the accidental transformation condition. This experiment has been replicated several times, in various forms, mostly with success (Light, Buckingham & Robbins, 1979; Dockrell, Campbell & Neilson, 1980; Hargreaves, Molloy & Pratt, 1982).

McGarrigle & Donaldson conclude that Piaget's classical procedure leads to an underestimation of the reasoning abilities of the child. They presuppose that in the normal interaction of adult and child, verbal utterances are consonant with the context of action. Therefore, Piaget's procedure is artificial and ecologically invalid. The transition from pre-operational to concrete operational thinking may rather be, they think, the expression of a growing ability to differentiate between language and situation, than of a revolution in the intelligent capabilities of children.

Donaldson has, indeed, introduced social psychological elements in her explanation of the conservation task, but her analysis is nevertheless unsatisfactory, because she insufficiently understands the experiment as a scene of interaction between experimenter and subject. She has analysed inadequately the part played by the experimenter, and the expectations of the child vis-à-vis the interaction. She gives no concepts which can be used to study the relationship between child and experimenter as an interactional setting. In this paper, I intend to contribute to the social psychology of the experiment, and particularly of the conservation task, by looking at the experiment in terms of the interaction of experimenter and child, and of the expectations with which the child approaches the experimental task.

Interaction and Metacontract

The Norwegian theoretician Rommetveit (1978, 1979) proposes that we investigate which presuppositions the participants in a conversation use and how such presuppositions influence their interaction. Rommetveit conceives of communication as the attempt by the interlocutors to transcend their private worlds and to create temporarily a shared, social world. The interaction is regulated by rules and tacit agreements, the most fundamental of which is the rule of complementarity: the speaker attunes his or her utterances to the listener, who, in turn, exerts himself or herself to understand what the speaker means. The accomplishment of complementarity is dependent on the consonance of the expectations and intentions the interlocutors start out with. Rommetveit denotes these most general expectations of the participants in a conversation by the term metacontract. The metacontract has a basic influence on the presuppositions the interlocutors harbour about the knowledge and motives of the other, and about the extent to which these are shared. The expectations, rules and presuppositions, in other words the metacontract, governing for example the communication between teacher and student, are different from those which govern their casual meeting as equal partners.

The metacontract creates a space in which the participants negotiate about the subject of the conversation, the way of dealing with it, the relevant background knowledge and the precise meaning of terms. The results of these negotiations, which can be called 'contracts', are continuously incorporated in already made agreements, and in this way a store of shared knowledge is built up, which functions as a base for action and verbal expression and as a condition for understanding what is said and done next.

These ideas can be applied to the interaction between experimenter and child in the experimental situation. Rommetveit (1978) suggested that the interaction in an experiment is regulated by the metacontract of the teacher-pupil relationship. The experimenter supervises the interaction, he or she formulates the problem and says which actions must be performed. The questions the experimenter asks are understood

by the child as questions the adult does not ask out of curiosity. The subject, therefore, will understand the situation as a context of instruction.

Rommetveit's suggestion must be amended in two respects. Firstly, characterising the experimental situation with the metacontract of the teacher-pupil relationship is not specific enough. Various forms of teacher and pupil roles exist between infant school and university. Rommetveit's idea, therefore, must be adapted to the interaction between adult and child in an instructional context, as characteristic of the age group participating in the conservation experiments. This specification, which will be carried out in the rest of this section, will necessitate a second amendment. In the experimental setting the child conforms to the metacontract of the teacher-pupil relationship, but the experimenter does not.

In order to apply Rommetveit's idea to the age group of children between 4 to 7 or 8 years, I shall now summarise some conclusions of the research on the interaction between adult and young child in instructional settings. When we know the characteristics of adult-child interaction in such situations, we may be able to draw conclusions about the expectations with which children begin interactions in a problem solving context. In particular, I shall build on two sources: 1. Studies by Wertsch (1979; in press; Wertsch, McNamee, McLane & Budwig, 1980) and by Wood, Bruner & Ross (1976), in which interactions between adults and children in a problem solving task are observed. Although the tasks in both cases are performed in the laboratory, they are carefully designed to simulate a natural context of interaction. 2. A group of studies originating with the project "Language at Home and at School" of the University of Bristol (Wells, 1981; MacLure & French, 1981; Wells, 1983). In this project spontaneous verbal interactions between adults and children in natural contexts are recorded.

In both the Wertsch and the Wood et al. study a child has to perform a puzzle task, assisted by the adult. In the Wertsch study a jig-saw puzzle has to be made in accordance with a given model (a truck). In the Wood task 21 blocks must be fitted together to form a pyramid. Both groups of investigators used children from about three to five years old. Wertsch made his investigation in order to study the

process of internalisation. He instructed the mother to induce her child to make the puzzle, and to help him or her when she thought this necessary. In the Wood design the experimenter herself assisted the child in performing the task. In doing so she followed a simple scheme: when the child was not able to get on, she first gave a verbal hint, and only if the child could not use this did she intervene more directly.

The Wood et al. experiment, because it does not observe spontaneous interaction, certainly presents more difficulty than the other study. Nonetheless, their article is very useful, because it tries to analyse the adult's help carefully. They speak of a "scaffolding process", which consists in the adult structuring the task in such a way that the child can make maximal use of his or her capacities. Wood et al. discern a number of "scaffolding functions", the most important of which can be summarised as follows:

- The interaction in the performance of the task is led by the adult. He or she induces the child to begin the task and to observe its rules, and sees to it that the child does not lose sight of the end-goal of the task. The adult subdivides the problem into parts and specifies subgoals. In doing so the adult pays regard to the child's capacities, by assigning tasks to the child which he or she can perform independently. Other tasks which are beyond the child's capacities are dealt with by the adult.

- The child's attention is directed by the adult to relevant aspects of the problem. The adult points out mistakes and explains how they can be prevented. When difficulties arise, the adult uses the opportunity to show the path to the solution.

In contrast to the Wood study, Wertsch gives excerpts of the communication between the adult and the child. He is particularly interested in the establishment of the problem solving strategy and the contributions of mother and child to reaching it. Therefore, Wertsch concentrates on verbal communication during the making of the puzzle. He analyses precisely how the mother induces her child to adopt a given strategy, and how she adapts her utterances to the actions of the child, but he does not mention when she places pieces of the puzzle herself. It is clear, however, from the material Wertsch presents, that

the mother structures the task, specifies subtasks, points out errors and explains them, just as Wood et al. describe.

The observations of Wertsch, moreover, yield two new, important results. First, he noticed that the mother adapts and in particular simplifies her instructions during the interaction, until the child understands them. In a typical interaction with her child of three years old, a mother tried to direct the child's attention by talking about the "wheels" of the truck. When the child did not understand this, she no longer used context-bound information, first by using words like "circles" or "rounds", ultimately by only using deixis ('this' or 'these', or simply pointing). A second finding of Wertsch is that children who do not understand the instruction, do not ask for clarification, but simply try. The mother can only infer indirectly, from erroneous actions, that the child did not comprehend her. This observation, indeed, is in accord with similar observations of children read to (Donaldson, 1978) and children participating in experimental tasks (Siegel & Hodkin, 1982).

The second group of studies, by Wells and his colleagues, is aimed at contributing to the knowledge of the differences and similarities between verbal interaction in the home and school contexts. The investigators recorded numerous interactions with children from about two to six years old in various social situations. For the purpose of this paper, the verbal exchanges in instructional settings or adult-assisted problem solving are particularly relevant. Examples of such exchanges are: (at home) conversations of mother and child reading a picture-book, a mother helping her child colouring a painting-book, a mother asking her child who has just visited them; (at school) the first reading lessons, classroom discussions about apples and the seasons, conversations during the presentation of slides.

As it turns out the interactions at home and at school in such situations of adult-guided problem solving are not essentially different. Such interactions are the rule in the classroom; at home, however, they mingle and alternate with other forms of interaction. In particular open, spontaneous conversations, based on mutual interest, and toward which child and adult can both take the initiative, occur relatively seldom at school. But the interaction schemes which are

characteristic of school life, are well prepared at home, and, for a summary of verbal communication in instructional settings (which I mainly base on MacLure & French, 1981), we need not differentiate between the contexts.

1. Question and answer sequencies normally have a three part structure: the adult asks a question, the child answers and the adult responds by giving an evaluative judgment of the answer. The questions are mostly pseudo-questions, i.e. questions which give the child the opportunity to demonstrate his or her knowledge, and to which the teacher knows the correct answer. The asking of a question is carefully prepared by the creation of a context. In the interaction the child's attention is directed to the relevant aspects to which the question refers, sometimes by verbal means, sometimes (e.g. in reading a picture-book) by pointing, or a combination of both.

2. The reaction of adults to mistakes and errors can be divided into two categories: "other corrections", in which the adult corrects the child by providing the right answer, and "invitations to self-correct", in which the adult makes clear that the answer was wrong, and invites the child to revise the answer. "Other corrections" appear to be quite rare, especially at school, and mostly follow several failed "invitations to self-correct". "Other corrections" are also found when the adult understands that the question is beyond the child's capacities. In the classroom the question has been given in the meantime to another child.

Interaction in the psychological experiment

Now that we have an idea of the normal course of communication in an instructional context, it is worthwhile to compare with it some developmental experiments. As an exercise I shall first treat two studies of conversation in which ambiguous information is given to the child. The contradictory results of these two experiments can be easily reconciled by assuming that the child expects to interact with a teaching or helpful adult. After that I shall set myself the more difficult task of analysing communication in the conservation experiments.

Hughes & Grieve (1983) asked children what they call "bizarre" questions, like "is red heavier than yellow?" (which involve category mistakes) and questions from which essential information is missing, e.g. "One day there were two people standing at a bus-stop. When the bus came along, who got on first?". The investigators found that their subjects (between five and seven years old) provided serious answers. The authors think that the children seek to make sense of the questions, or at least that they interpret them as meaningful. Donaldson, Grieve & Pratt (1983), in a commentary on this study, write that it has been proven again how ingeniously children make sense of situations. It is, however, not necessary to suppose that such a question is absurd or meaningless to children and that they try to make the best of it. The answer of the children is remarkable only in appearance, and it appears so only because the communication is robbed of its normal sequential structure. Instead of providing feedback to the child's answer, the experimenter only asked "why?", and after that tried his next bizarre question. As we saw in the previous section, children usually do not react to uncomprehended statements with a request for clarification. In the Hughes & Grieve study, the children give a serious answer, confident that the experimenter has sincere intentions and that they will be corrected or provided with new information. Even the older children, not able to suppress surprise, answered. Some children formulated their answer in an interrogative form, thereby inviting the experimenter to make the next move in the interaction. For their answer to the question about who got on the bus first, many children appealed to rules of queuing ("The one who got there first") or rules of good matters ("The lady." "Why?" "Because ladies should go first before men."). It is a mistake to think that the children make sense of a situation. Rather, they anticipate more information from the experimenter, which in a normal communication would have been provided.

Campbell & MacDonald (1983) told children (three and four years old) stories which contained words sounding the same, but having two distinct meanings, a familiar and an unfamiliar one, like hair/hare, boy/buoy, wing. E.g.: "That afternoon, Jane and her Mummy and Daddy went for a picnic in the car. As they were driving along they saw a

hare run across a field." (p. 119). When they were asked after that to draw a "hare", many children drew a hair or a head full of hair. Donaldson et al. comment: "We must therefore acknowledge that, alongside the desire to make sense of things, there may also be observed in children a certain capacity to accept and tolerate the nonsensical." (p. 115) -- a statement contradictory to their interpretation of the Hughes & Grieve results. Now, the comment is certainly true, but not in this case. Here, also, the explanation of the behaviour of the child must be sought in his or her expectations and in the disturbance of the dialogue structure by the experimenter. The story, of course, is not well understood by children who do not know the word 'hare'. But instead of "accepting the nonsensical" they believe that the experimenter is telling them something meaningful and that things will soon be clarified. In a normal instructional interaction this would have been the case.

Because of its lack of sensitivity to the child's needs for information the communication in these two experiments resembles in some respects the disturbed communication in families with schizophrenic children, as analysed by the Palo Alto school and investigated experimentally by Sølvberg & Blakar (1979). It leads to the "state of alienation", which according to Rommetveit (1979) occurs when a metacontract is broken by one of the interlocutors. Because the experimenter does not observe the rules of the metacontract to which the child conforms, the conversations in these experiments are incapable of revealing the cognitive capacities of children. The child does not make the situation meaningful -- the experimenter, by deviating from the normal pattern of communication in this kind of situation, makes it meaningless.

The classical conservation task of Piaget can be illuminated in the same way. Irrespective of the precise details of the presentation of this task, it involves, as Donaldson (1978) points out, drawing a child's attention to perceptual characteristics of the situation which are irrelevant to the problem: "Look at the rows, watch what I'm doing" etc. In this basic sense the conservation task deviates from normal patterns of communication in a context of instruction, in which, as we

saw, the child's attention is directed to the important elements of the problem situation.

In the Genevan tradition, however, the child's answer to the conservation question is followed by an interrogation, according to the rules of the clinical method. Experimenter and child engage in a prolonged interaction. The question therefore can be raised, if the clinical interview conforms to the rules of the metacontract of instruction. An affirmative answer could perhaps necessitate us to adopt a less harsh attitude toward the conservation task. No communication analysis of the clinical method has thus far been presented. Therefore, I have compared examples of the clinical method (excerpts of the pre- and post-tests in Perret-Clermont (1980)) with what can be considered as normal patterns of interaction in an instructional context. The following conclusions, of course, are only a beginning and I admit that they have an impressionistic character.

The following traits of the clinical interview are conspicuous. The utterances of the child are never met by a clear feedback: the usual three part structure is absent. Instead the experimenter makes counter-suggestions, like: "Yesterday a little boy who came here told me that there is the same to drink. What would you say to him?" Invitations to self-correct are seldom found. Instead, the conservation question is repeated endlessly. It is usual that the experimenter repeats an answer of the child in a summarising form, and then asks: "Is this right or not?". Sometimes, when a child does not finish an argument, the experimenter presses the child for an answer. Only occasionaly, I found direct assistance, e.g. in a conservation of number task an incitement to count (which did not help the child). The experimenter keeps responding to the child's answers: "Why? How do you know?". Once I noticed the experimenter correcting the child directly by confronting him or her with the right answer: this example of 'other correction' was probably more of a shock to the child, because it did not make for progress in the task. In summary: no clear evaluation of the statements of the child, no explanation or pointing out of problems, no, or at least no comprehensible, invitations to revise the answer. A harsh attitude towards the use of the clinical interview in the conservation experiment is therefore justified.

The behaviour of the experimenter in the conservation experiment must be conceived of as connected, not to the metacontract of instruction, but to another metacontract, that of testing or examination. The rules of this metacontract may be thought of as: little orientation to the problem, no immediate feedback, no or inadequate assistance in solving the problem. This metacontract may be familiar to older children, who have had some years of experience at schools, and who have learnt to observe its rules. I did not find such forms of interaction in the studies by Wells and his colleagues. Ignorance of the interaction rules of examination may contribute to the failing of young children in the conservation task. This conclusion, I think, holds good both for the classical procedure (with clinical interview) and for the neo-Piagetian variants (without clinical interview). I doubt, wether there is, from a communicational point of view, an essential difference between the two versions of the task.

As child and experimenter behave according to different metacontracts, the child may understand the utterances of the experimenter in a way quite different from that intended by the latter. The "why?" questions, in some cases, may be interpreted more as conveying information (e.g. approval or disapproval) than as requesting further explanation. In the light of this, the pretension of the clinical method to be a form of rational discussion appears to be quite naïve.

Another way to illuminate the idea that the interaction in the conservation experiment is an alienated relationship is to look at experiments in which a common metacontract is in fact observed by the participants in the task. This is the case in studies by Doise, Perret-Clermont and others (Doise, Mugny & Perret-Clermont, 1975; Perret-Clermont, 1980 and Perret-Clermont & Schubauer-Leoni, 1981), who use the conservation problem in group settings. According to these authors, the learning of conservation abilities, and cognitive abilities in general, is facilitated in group contacts. I borrow a characteristic example from Perret-Clermont (1980, chapter 2). A large group of children was divided into three groups, according to their individual performance on the pre-test, a conservation of liquids test: conserving subjects (C), non-conserving subjects (NC) and intermediate

subjects, oscillating between conservation and non-conservation, or unable to justify a good answer (I). Two or three weeks after the pre-test, 37 groups of three children are formed, each containing two conserving subjects and one non-conserving or intermediate child (the experimental subject). In the collective sessions the experimental subject is asked to pour juice for the other two, who, of course, have glasses of different format. Only when the three children agree that the juice has been shared equally, the experimental subject is allowed to have his or her glass filled and all three are able to drink. The idea behind this experiment is that the non-conserving subject will be misdirected by the perceptual appearance and that the two conserving subjects will protest against their unequal shares. The discussion which follows is expected to stimulate positively the cognitive development of the non-conserving subject. The post-test (the same task as the pre-test) showed that 24 of the 37 experimental subjects had made progress, compared to 2 out of 12 subjects in a control group, who did not participate in the group sessions.

The differences between pre- and post-test levels are not our main interest. First, because the 'operational level' of the children is determined by means of a procedure which is criticised in this paper. Secondly, because there is every reason to doubt the validity of such a division, as we shall see in the next section. It is more interesting to reconstruct what happened in the collective sessions. Although in these experiments there is no adult - child interaction in the solution of the task, it is reasonable to assume that the interactions between the children have much in common with the adult - child interaction in a context of instruction. Apart from the cooperative atmosphere in which the collective sessions mostly occurred, an element of instruction between younger and elder children was probably present. In a pre-study it appeared that the older children generally are conserving subjects and the younger ones non-conserving.

Unfortunately, Perret-Clermont's book, despite its extensive descriptions of the conversations in the pre- and post-test, contains only five short excerpts of the discussions in the collective sessions (p. 49-52). These excerpts create the impression that the conserving subjects not only presented arguments, but also gave instructions to

the experimental subject on how to act, e.g. how to use a fourth glass to fill the glasses equally. Another impression is that the conserving children adapted their clarifications to the understanding of the situation which the experimental subjects showed in their behaviours and utterances. In these two respects the interaction is similar to that in Wertsch's study. It goes without saying that it is impossible to draw conclusions based on five excerpts. What we would like to know -- how the experimental subject learns to solve the conservation problem in the collective session, or at least comes nearer to the solution -- is invisible because of the insufficient information the author supplies.

Nonetheless, Perret-Clermont formulates and tests some hypotheses on the causes of the cognitive progress, which illuminate the interaction in the collective sessions and its effects. She rejects an explanation in terms of imitation (Rosenthal & Zimmerman, 1972), making use of the various grounds conservation can be justified with. More than half of the subjects showing progress, she concludes from her data, produced arguments in the post-test which were not uttered by the conservers in the collective session. Others interpret the cognitive change in the experimental subjects as the effect of social pressure, which induces the non-conserving subjects to conform to the majority. Perret-Clermont can parry this explanation, because she observed that in some instances the non-conserving subject convinced the other subjects of the wrong conclusion. Nonetheless, sometimes these experimental subjects revealed themselves as progressed to conserving subjects in the post-test. Perret-Clermont interprets her results by means of a Piagetian conflict theory. The progress is not caused by the interaction with partners who produce the right point of view, but rather by the confrontation with a different point of view, be it right or wrong. Such a confrontation leads to a disturbance of the cognitive equilibrium, which may produce a reorganisation of cognitive structures.

Perret-Clermont's interpretation is unsatisfactory in three respects. Firstly, she hardly clarifies the nature of the cognitive conflicts, because she gives no details about what exactly happened in the collective sessions. Secondly, she does not consider the

possibility that the cognitive changes are the result of processes of internalisation. The excerpts of the discussion in the collective sessions give some support to the claim that the same mechanisms were working there as Wertsch showed to be present in his studies of internalisation. In particular, it may be that the non-conserving child is stimulated to understand the problem situation, precisely because he or she is induced to carrying out the behaviours specified by the other children (cf. Wertsch, 1979, p. 20). Thirdly, Perret-Clermont demonstrates the cognitive changes in the children in the classical conservation task. Why not bring the experimental subjects, as a post-test, in other groups which have to solve similar, but not identical tasks? It would be interesting to see how the children increasingly are able to understand the problem and how they find novel arguments to express this understanding.

I want to demonstrate again the importance of interaction variables in the conservation task with the well known experiment by Rose & Blank (1974). These investigators wondered if the repetition of the conservation question may be a signal to the child to change the previously given answer. Under natural conditions, they suppose, a question is never asked twice without a sufficient ground. To test their idea, Rose & Blank presented a conservation problem of number to three groups of six-year-old children. In the experimental group they performed the transformation, but asked the conservation question only after it. The subjects in a first control group had to undergo the classical procedure with the question repeated, whereas a second control group did not see the transformation and was asked to judge the situation only in its static, transformed form. In comparison to the two control groups, the experimental group contained a substantially higher proportion of conserving subjects. From the difference between the experimental and the second control group, Rose & Blank concluded that the effect is not a matter of solely asking the famous question once, but that the overall context is an important condition.

As the cognitive levels of the children in this experiment according to Piagetian criteria did not differ, it disproves Piaget's theory. But Rose & Blank also refute part of Donaldson's theory, according to which the large amount of errors in the classical

procedure is ascribed to the experimenter directing the child's attention unjustly to the transformation. In the Rose & Blank design, the attention of the subjects in the experimental group is also led to this irrelevant aspect: "Look at the rows, watch what I'm doing" etc., and in this respect it is not different from Piaget's procedure. Therefore, from Donaldson's point of view, no difference would be predicted between Piaget's original design and a one-judgment condition. Here, again, Donaldson's interpretation appears to be insufficient. The solution, rather, must be sought in the structure of the interaction between experimenter and child.

Rose & Blank's hypothesis is supported by an observation by Walkerdine (1982). She observed question and answer sequencies between a teacher and a class (children between three and five years old), in a game used to teach and rehearse counting. Every time the teacher asked a question, the children had to chorus "yes" or "no". Walkerdine recorded that the teacher reacted to a mistaken answer by simply repeating her question. This repetition seemed to function as a signal, that the previous answer was wrong, because the children in chorus repaired their mistake. It may be that repetition of a question has a conventional significance in the interaction between adult and child. But I did not find other instances of this effect in the literature of verbal interaction.

The Rose & Blank experiment has been replicated several times with different conservation problems and younger age groups, by Silverman (1979), Neilson, Dockrell & McKechnie (1983) and Samuel & Bryant (1984). The results of these replications were not unanimous. It is doubtful, I think, if we will gain much by doing replications, before the effect of repetition of a question is studied in everyday, natural circumstances.

The study of cognitive development

Some critics of Piaget, who reject the classical conservation task as a means to investigate the cognitive ability of children, appear to think that children master the conservation problem at a much earlier age than Piaget contended. The age question, however, is a mistaken

question. The evidence is piling up that this question cannot be answered. There is no clear point of transition between the moment a child is not yet able, and the moment a child is able, to solve any conservation problem. I am not refering here to 'horizontal decalage' which according to Piaget exists between the conservation of number, weight and volume. Research into the Piagetian tasks is forced to the conclusion that the achievements of children vary according to task and situation, and this conclusion applies as well to tasks which make logically similar demands on the child. We have to abandon the presupposition which implicitly has guided much research, that the cognitive abilities of children, when they have reached a certain level, are relatively stable across different situations. Piaget's contention that children can only conserve at about age seven is as wrong as the claim of his critics that they can at a much younger age.

Before we dwell on this point, some more examples. Perret-Clermont mentions in her book that some children, classified as conserving subjects in both the pre- and post-test, in the collective sessions behaved as intermediates or even as conservers. Characteristically, she calls this "regression". On the other hand, some non-conserving subjects revealed themselves conservers in the group settings (Perret-Clermont, 1980, p. 51 and 108. Unfortunately, she does not give precise numbers.). Another example shows that some conservation problems present serious difficulties to adults. Van Geert (1979) presented problems of the conservation and non-conservation of area and perimeter to university students. Many mistakes were made; in some tasks more than 80% of the subjects gave the wrong answer. Van Geert concludes that adults, too, achieve well only in tasks which are familiar to them in daily life.

In a review article Rogoff (1982) assembled such evidence in three categories, as to whether the performance varied as a function of the familiarity of the materials and the problem, the meaningfulness of the problem, and the social situation. She speaks of a "limited generality of performance across logically equivalent tasks" and summarises her review: "children's characteristics appear to vary widely as a function of the task and setting (...)" (p. 125).

The Piagetian camp defends its position by claiming that the early conservation in children is no real conservation, but "pseudo-conservation". Bovet, Parrat-Dayan & Deshusses-Addor (1981) tried to show this in a replication of the Light et al. study. Instead of a plain answer, such as Light and his colleagues were satisfied with, they asked their subjects to give a sufficient justification of their answers. Many children who answered the conservation question correctly could not give a rational argument for it. The authors assume that the availability of the correct arguments in the child depends on the presence of the system of concrete operations. The answers to the conservation question in children who could not justify them therefore were, according to Bovet et al., the result of an experimental design leading the children to the right answer.

This defence is hardly convincing, because it does not sufficiently account for the situation- and task dependency of cognitive performance. These authors seem to think that the situation may mislead the pre-operational child into an uncomprehended correct answer, but that, once the level of concrete operations is reached, the child possesses an ability which is not influenced by the situation. But the availability of a cognitive ability is not a matter of possessing or not possessing. In my view, cognitive development should be represented as a gradual process, which progresses in variant fields at an unequal pace. The growing understanding in children of the problems they are confronted with and their increasing ability to express their understanding verbally is connected to their everyday experience, and is therefore not synchronous across different fields of problems. The idea of "structures d'ensemble", which Piaget kept repeating, despite disappointing experimental results, (e.g. still in 1972) and in which the individual's logical abilities are conceived of as a coherent system (being revolutionised several times in ontogenesis), can only be maintained by making rigid criteria, as in the Bovet et al. study. Cognitive development does not lead spontaneously to general and generalisable concepts, but should be thought of as the development of specific cognitive abilities, which are more or less tied to particular contexts. This does not mean that these concepts cannot be generalised, but their application to a new

situation cannot be taken for granted; it is the result of a process of active construction.

In keeping with this point of view, an experimental task should not be considered as a means to reveal the competence the child possesses. Many investigators, either explicitly or implicitly, adhere to the view that the child's achievement in an experiment is "a selection from a repertoire of behaviors" (Goodnow, 1972, p. 84). If a child is able to pass the test, the argument runs, it can be concluded that the relevant skill is present in the child's repertoire. The experiment should, on the other hand, be thought of as a novel situation (unless, of course, a child has direct experience with the task presented), to which the child must adapt and transmit existing knowledge by active construction. The experiment is not a window on competence, but an "opportunity for learning" (Perret-Clermont & Schubauer-Leoni, 1981). Children's failures in the conservation task do not allow us to conclude that they do not have any knowledge of conservation problems, but that they do not succeed in adapting their knowledge to the novel problem situation presented to them in the experiment. The question as to whether a child is a conserver or not only brings us into insoluble criterion problems. It would be more fruitful to study microgenetically the adaptation of a child's existing knowledge in unfamiliar contexts.

Conservation in everyday life

The ideas proposed in the previous section inevitably lead to a reorientation of the attention to children's daily experiences. In their everyday life children are confronted with conservation problem and learn to solve them. Russell (1978) and Light (1983) proposed to consider the origins of conservation abilities in the light of cultural practices of thinking and acting which involve those abilities. Children learn to use concepts like number, weight, quantity in socially transmitted and prestructured activities, such as counting, weighing and dividing. Children participate in those activities and in doing so appropriate the criteria which apply when it must be judged whether a property has changed or not. Children do not first learn the

concept of weight and, next, that the weight of an object is conserved despite transformation of its external appearance, but rather learn conservation and the criteria to establish it as an inherent aspect of the concept of weight. These authors do not, like Piaget, treat the conservation abilities as isolated logico-mathematical abilities, but they place them in the context in which they are learned: a child's everyday life in a particular culture. Hitherto the development of conservation and other cognitive abilities, however, has not been studied in natural circumstances. I shall therefore present here some observations of children engaged in daily activities, which are relevant to the understanding of conservation.

Obs. 1. My daughters C (3;7) and E (2;0) with their mother at supper. Corncobs are distributed. The mothers cuts E's cob in two. C asks: "Why does E get two cobs?". Mother: "E does not get two. I have cut it, because it will cool sooner." (End of the conversation on this topic.)

Obs. 2. A family at the breakfast table. One of the children (4 years old) is accustomed to get a slice of bread cut in four parts. Because he is a slow eater, his parents today have cut his slice in eight smaller parts. The boy refuses to eat more than four parts, argueing that he never eats more than one slice of bread (Vroon, 1983).

Here are two examples of the conservation problem in daily life. The mother in obs. 1 does not only answer her child's question by saying that she has cut E's one cob in two halves. but also why she did so. According to Donaldson (1978), a problem is easier solved by a child, when the goal of the situation is clearer. It may be that the mother uses this rule intuitively. C did not continue the conversation about the cobs, which does not imply that she understood the situation perfectly. Vroon mentions that his son did not accept any explication, and that he kept refusing to eat more than four parts, even after several days. In the end, of course, his parents cut his slice in four parts again.

Obs. 3. "I am often amused at my sons. E.g. when Stephan (2) was so clever to exchange his icecream, eaten more than half, for that of his elder brother (4), who had only eaten a little bit." A father in Libelle, December 2nd, 1983.

Negotiating about quantities frequently occurs in children, and this could be a source of information about the development of reasoning abilities. The Stephan of obs. 3 is a clever boy, indeed, but the willingness of his brother to join the exchange is probably more kindness than a lack of understanding of the situation. This does not alter the fact that Stephan displayed a remarkable understanding of relative quantities.

The development of one-to-one correspondence is an important precondition of the conservation of number. Obs. 4 to 7 have to do with this concept.

Obs. 4. I observed several times the division of sweets at birthday parties. The children (between two to five years) crowded round the hero or heroine of the feast, sometimes shouting: "I have not had any yet!".

This observation is an example of a context, in which children learn one-to-one correspondence (one sweet for every child). The children prevent the child who divides the candy from making a mistake, because a child left out protests.

Obs. 5. I was busy laying the table and I just had put four plates at the table. I gave E (2;8), who wanted to help, the children's forks, spoons and knives (my two children have their own particular spoons and forks), saying: "You can lay the table for the children". E laid the spoons, forks and knives perfectly by the side of the plates at the children's regular places.

Obs. 6. Strawberries for dessert. C (4;2) exclaimed: "I will divide them". Four plates were put next to the dish full of strawberries. C then realised that not all strawberries have an equal size: "they are not equally big". I suggested to her giving everybody a big one at first, then a small one, then a big one, etc. She repeated that they were not equally sized (this time she meant: the big ones are not equally big, and the small ones not equally small). Then she started dividing. First she put one strawberry in each plate, counting aloud: one, one, one, one. In the second round, counting aloud: two, two etc., she did not keep the same order as the first time. In the next rounds, she made two kinds of mistakes: sometimes she counted out four strawberries all right, but put two in one plate, thereby missing

one. Or she lost count and divided five strawberries in one round. The problem of the big and small strawberries had long been forgotten.

Obs. 7. C (4;3) has divided strawberries on her own initiative several times since obs. 6. Now she succeeds in dealing out without mistakes up to four strawberries. She always counts aloud: one, one, one, one, two, two, etc. She can also keep the same order of the plates. After four strawberries she loses the right order.

The learning of one-to-one correspondence occurs in natural circumstances like laying the table and dividing. Parents and other children support this learning process, as in obs. 4 and 6, by intervening, explaining, making suggestions. The situation of obs. 6 and 7 has much in common with the way the number must be verified in a conservation of number task. It is striking that C in obs. 6 is alive to the problem of the proportion of number and size of the strawberries (a beginning of the concept of compensation, which is so important in the conservation of continuous quantities). It is probable that C in obs. 7 cannot do more than four strawberries because of overload. There is no reason to assume that she will not extend the quantity gradually. In this way the child's knowledge is growing. Therefore, the reproach of Bovet et al. to McGarrigle & Donaldson (1974), that they use only four counters instead of the seven Piaget used in his original task, is beside the point.

Obs. 8. C (3;10) made beads on a string. There were plenty of large wooden beads, existing in five different forms (sphere, cone, counter etc.), each form having its own colour. C made a string of fifteen beads, in groups of three beads of the same form/colour. As the lengths of the spheres differ from the lengths of the cones etc., C solved in her play a problem of the conservation of number: she used three beads of the same form/colour at a time, disregarding the lengths of the groups of beads.

I present these observations only to show how conservation and related problems arise and are solved in daily life. Such observations would enable us to analyse and to understand the construction of cognitive abilities in the course of the developmental process. Under the spell of the mature Piaget, developmentalists have studied the development of children's cognitive abilities isolated from their

everyday context. We should rather turn to the young Piaget, who did try to understand cognitive development as a reaction to problems of everyday life. For example, Piaget (1948) wrote that the discovery of death brings children to revising their ideas of causality, and to appropriate the idea of chance.

Conclusions

To end up, let me summarise my conclusions.

1. In the same way that social psychologists have become aware of the "demand characteristics" of the experimental situation (Orne, 1962), developmentalists should analyse the presuppositions and tacit understandings which underlie the experimental relationship between experimenter and subject. For a child the conservation experiment is not a purely cognitive task and the communication between child and experimenter is not led exclusively by the rules of argument. The child, in beginning the task, does expect some things to happen and other things not to happen. In particular, the child has expectations towards the interaction and the behaviour of the experimenter. Only when we know the conventions regulating the interactions between adults and children in daily life, will we perhaps be able to understand the child's reactions in the conservation experiment.

2. In the conservation task children are confronted with an extremely difficult social situation, because the course of communication differs from what they expect. They perceive the situation as a context of instruction. The experimenter, however, acts according to a different metacontract, that of examining or testing. Young children have not learned to recognise this metacontract. Because the experimenter breaks the metacontract, a "state of alienation" (Rommetveit) is created. It is doubtful, if such social conditions are a suitable occasion for the study of cognitive development.

3. To gain insight into the development of cognitive abilities, we should study how they originate in everyday, natural circumstances. Children grow up in a multitude of social contexts and influences. It is not certain, indeed improbable, that every context of the child's activities promotes or supports the construction and appropriation of

knowledge. We must acquire a better understanding of those contexts, before we can fruitfully simulate them in the laboratory. My plea for observations of children in their daily lives, should not be interpreted as a rejection of laboratory studies, as some advocates of ecological validity do. But as long as we do not know how a child perceives the conservation task, it impedes rather than promotes our understanding of cognitive development. Therefore, I do not follow Bryant's (1982) conclusion, that developmental psychologists, although they have rejected many ideas of Piaget, have accepted his experimental methods.

4. A contextual approach should replace those theories which take children's cognitive abilities as properties they posses and which are more or less independent of context. This view is alive both in Piagetians and in many critics of Piaget. But, as Rogoff (1982) remarks, we cannot conceive of any situation revealing cognition in a pure form. Each situational frame of children's activities -- whether school, home, playground or the laboratory -- is a context playing a part in cognitive achievements. The influence of context should be understood: it is impossible to eliminate it. Context is an integral aspect of every cognitive activity, not a disturbing factor which we should control for.

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